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U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION
Division of Forest Insect Research

FOREST INSECT CONDITIONS MOUNT LAGUNA RECREATION AREA CLEVELAND NATIONAL FOREST APPRAISAL SURVEY OCTOBER 1957

Ret to R.L. Smith

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Introduction

Forest management of the Laguna Mountain Recreational Area on the Cleveland National Forest has never been simple. An area of marginal site, low rainfall and high recreational use, it seems to have long been afflicted with problems leading to serious tree mortality. Insect control to curtail this mortality has been carried on sporadically since about 1926. Several entomologists and pathologists have studied the insect and disease problems involved, often with differing results.

In October 1957 the Station undertook to make a coordinated insect and disease survey of Mt. Laguna in order to determine if possible (1) the correlation between insect and disease incidence, and (2) the direct and contributing factors leading to tree mortality. This appraisal was made on October 14 to 17, 1957, with the cooperation of the following agencies and individuals: (1) California Division of Forestry personnel Dan Dotta, Bob Blanford, Joe Springer, Jerry Tipton and Ed Kaiman; (2) Cleveland National Forest representative Don Keisler; and (3) Experiment Station personnel H. H. Bynum and G. C. Trostle.

Host, Insect and Disease Species

The major coniferous tree species on Mt. Laguna is Jeffrey pine. The principal secondary species are Coulter pine and incense-cedar. The green stand volume of merchantable timber was estimated in 1953 to be 6,500 board-feet per acre.[1/] The average tree probably is between 15 and 16 inches d.b.h. An occasional large tree over 3 feet d.b.h. can be found in the stand, but most of the large trees have been killed.

The timbered area on this mesa-type mountain top is surrounded with brush and interspersed with meadows and brush patches. (See map) The terrain, even though on a mountain top, is relatively level and the stand is open with little underbrush except where the heavy brush patches occur. These factors all help to make cruising and spotting infested trees relatively easy.

1/ Hall, R.C., M. M. Furniss, G.L. Downing. Forest insect conditions, Mt. Laguna Recreation Area, Cleveland National Forest, Feb. 1954, Appraisal Survey. Calif. Forest and Range Expt. Sta., Berkeley, Calif. 5 pp. April 29, 1954.

Jeffrey pine is the most common host of the California flatheaded borer, Melanophila californica Van Dyke, in the southern California areas. Coulter pine at times has been damaged by western pine beetle (Dendroctonus brevicomis Lec.) infestation, but during this survey only one infested Coulter pine was found. Other workers have found the California five-spined engraver, Ips confusus (Lec.), the Oregon pine engraver, Ips oregoni (Eichh.), and the red turpentine beetle, Dendroctonus valens Lec. to have caused serious damage in both Jeffrey and Coulter pines in the past.[2/] These insects were recorded during this survey when they were found in a tree. Root infestations by red turpentine beetles were watched for carefully and tabulated when found.

Diseases have also done their part in damaging the Mt. Laguna stands during past years. At times root rots, Fomes annosus (Fr.) Cke. and Armillaria mellea (Vahl.) Quel. have appeared in trees containing flatheaded borers, but infection by rots has not been consistent.[3/] Hard pine dwarfmistletoe, Arceuthobium campylopodum Engelm. f. abietinum, has been an ever increasing problem for a number of years. Small trees are misshapened and killed by this parasite.

Survey Methods

The timbered area surveyed was approximately 7,500 acres in size. A 2 1/2-percent sample of this area was taken, using 386 half-acre plots placed at 5-chain intervals along predetermined lines. (See map) This method of sampling is similar to the appraisal methods used in previous surveys in 1953[4/] and 1954.[1/] For this appraisal, however, all trees were recorded in which all or part of the crown was fading, including individual branches. The trees killed in 1957 were also recorded.

On currently fading trees information was obtained not only for the insect infesting the bole, but for other causes of damage as well. The information taken was as follows:

1. Tree diameter for trees 2 inches and over.

2. Insect species infesting the bole. Flatheaded borers were recorded as either incipient or fast growing.

2/ Cox, David and Callaham, R.Z. A study of insects associated with Jeffrey pine mortality in the Laguna Mountain Recreational area, Cleveland National Forest. Bur. Ent. & Pl. Quar., Berkeley, Calif. March 30, 1953.

3/ DeLeon, Donald. Some biological considerations of the 1940-41 Mt. Laguna Recreational Area control job. Bur. Ent. & Pl. Quar., Berkeley, Calif. May 22, 1941.

4/ Hall, R. C. Forest insect problems in the Mt. Laguna Area, Cleveland National Forest. U.S. Dept. Agr., Bur. Ent. & Pl. Quar., Berkeley, Calif. 2 pp. March 3, 1953.

3. Red turpentine beetle attacks, recorded by the number of quarters of the bole containing pitch tubes and total numbers of tubes found.

4. Discoloration in the crown, classified by the number of thirds discolored.

5. Number of dying branches, and in which third of the crown they occurred.

6. Occurrence of mistletoe, classified as light, medium, heavy or stem infection.

7. Woodpecker work, classified as to none, light, medium, or heavy, and on which thirds of the bole it occurred.

8. Resin flow on bole, recorded for all damaged trees when it was evident.

Root inspections were made in suspected areas to determine the incidence of root rots such as those which have been reported from the Laguna area.

Results

The injured and dying trees found during the course of this survey showed five types or causes of injury: red turpentine beetle, California flatheaded borer, hard pine dwarfmistletoe, resin flow and dying branches. (Table 1) Engraver beetles and roundheaded borers were not found to be abundant enough to be considered important. No infections were found of either Armillaria or Fomes root rot on the plots.

The affected trees were predominately in the smaller d.b.h. classes. About 74 percent were from 2 to 10 inches in size. The remaining 26 percent varied from 12 to 36 inches, with an average diameter of 18 inches. Damaged trees below 12 inches d.b.h. averaged 1.36 per acre, whereas sawtimber-sized trees averaged 0.47 trees per acre. The volume of sawtimber-sized trees damaged totaled 1.16 million board-feet, or an average of 155 board-feet per acre. The approximate volume of smaller trees damaged was only 45,000 board-feet, or an average of about 6 board-feet per acre. Thus, in 1957, the total volume affected on the entire 7,500 acres was about 1.2 million board-feet. In 1953 the stand reportedly contained 6,500 board-feet per acre.[1/] Based on this volume, the 1957 damage amounts to about 2.5 percent of the stand or about 5 times the estimated normal loss. Perhaps the most serious feature of this situation is the extremely high loss of the smaller trees which are badly needed to replenish the stocking.

Hard pine dwarfmistletoe was the most common cause of injury, but almost as many trees were affected by the California flatheaded borer as by mistletoe. Most of the trees with borers contained fast-growing larvae, which only develop when the trees near death (Table 2). This points

toward the conclusion that in 1957, at least, the California flatheaded borer was the major immediate cause of tree mortality in the Laguna area, despite the fact that mistletoe infection was a little more prevalent than flathead damage.

There was a close parallel between the proportion infested by flatheads and by mistletoe. In the smaller diameter classes the proportion was somewhat more than 50 percent, with the percentage rising to 100 for both organisms in the larger diameter classes. This suggests that mistletoe and flatheaded borers in combination are the primary cause of the damage. When the number of borer-attacked trees infected with mistletoe is compared with the number attacked by borers but not by mistletoe, a different conclusion is indicated. Only about one-third of the trees in each diameter class contained both flatheads and heavy or medium mistletoe infections. Another third contained flatheads but no evidence of mistletoe or only light infections. The remaining one-third had medium to heavy mistletoe infections only.

Aside from flatheaded borers and dwarfmistletoe, dying branches were the most frequent type of injury. Trees having dying branches were far fewer than those with borers or mistletoe. Like most of the other types of injury, dying branches most often occurred in the larger diameter classes (Table 3). Both flatheads and mistletoe are probable causes of dying branches.

Red turpentine beetle damage ranked fourth in frequency of occurrence. Attacks by this insect were not very closely associated with flatheaded borer damage. Most of the red turpentine beetle attacks were not aggressive and were usually confined to a single quarter of the tree's circumference. These findings indicate that this beetle in 1957 was not a particularly serious problem.

Trees showing resin flow were least abundant. The significance of this type of injury and its cause are not known.

From the data obtained there appears to be some correlation between the diameter of trees less than 12 inches d.b.h. and the occurrence of the various factors considered in the survey. Even though almost half the trees recorded were in the 2- and 4-inch classes, trees in those size classes showed the least incidence of any of the factors except crown kill. At least 3 possibilities could cause this difference, although no clear-cut proof exists that any one of the three is correct.

1. The factors considered may be more difficult to identify in the smaller trees. This lack of signs could be due either to poor development of symptoms in smaller trees, or to the death of such trees before the symptoms become evident.

2. It may be that the smaller trees are killed by a single factor. Conversely, in larger trees several factors may be needed to cause mortality.

3. There may be a major factor, not discovered, which affects the smaller trees.

Discussion

The results of the survey indicate the California flatheaded borer to be the most serious immediate cause of tree mortality in the Mt. Laguna area. The level of infestation as of 1957 was of epidemic proportions. Because flatheads are not the sole factor contributing to stand damage, all-out control against this insect alone cannot be expected to prevent additional losses entirely. Mistletoe and other factors affecting the stand undoubtedly will continue to take a toll regardless of whether or not flatheads are controlled. More knowledge about how the various mortality factors operate continues to be the major need in this area.

It was observed during the survey that where maintenance control has been practiced in and around campgrounds, the borer damage seemed to be lighter. This effect, however, was probably more apparent than real, and due mainly to the removal of currently infested trees. Grouping of infested trees indicates that insects emerging from a host tree are more likely to attack a neighboring tree than one at some distance. Localized control work may help reduce concentrations of borer-infested trees around campgrounds and cabin sites.

Berkeley, California
July 14, 1959

Attachments:
Tables 1, 2, and 3
Map

Table 1.--Number of damaged trees on sample plots, by diameter and type or cause of injury[1/] Mt. Laguna Recreational Area

Diameter class	Red turpentine beetle	California flatheaded borer	Hardpine dwarf-mistletoe	Resin flow	Dying branches	Total number of injured trees[2/]
Inches						
2	2	48	53	4	9	91
4	8	55	51	13	19	83
6	5	33	33	8	16	45
8	6 (26)	17 (164)	19	8	8	26
10	5	11	14	5	5	18
12	6	14	14	6	6	19
14	10	17	18	1	6	21
16	5	14	14	6	6	16
18	6	9	12	4	5	13
20	1	4	4	0	3	4
22	0	1	1	1	1	1
24	0	2	1	0	2	2
26	1	2	1	0	0	2
28	0	4	4	0	2	5
30	0	1	0	0	0	1
32	0	1	1	0	1	1
34	3	5	3	0	3	5
36	1 (59)	1 (239)	0	0	1	1

1/ Basis: 396 half-acre plots.

2/ Some trees had more than one type of injury, so that entries in each diameter class are not additive.

Table 2.--Frequency of California flatheaded borer and hard pine dwarfmistletoe damage on sample plots, by diameter class.[1/] Mt. Laguna Recreational Area

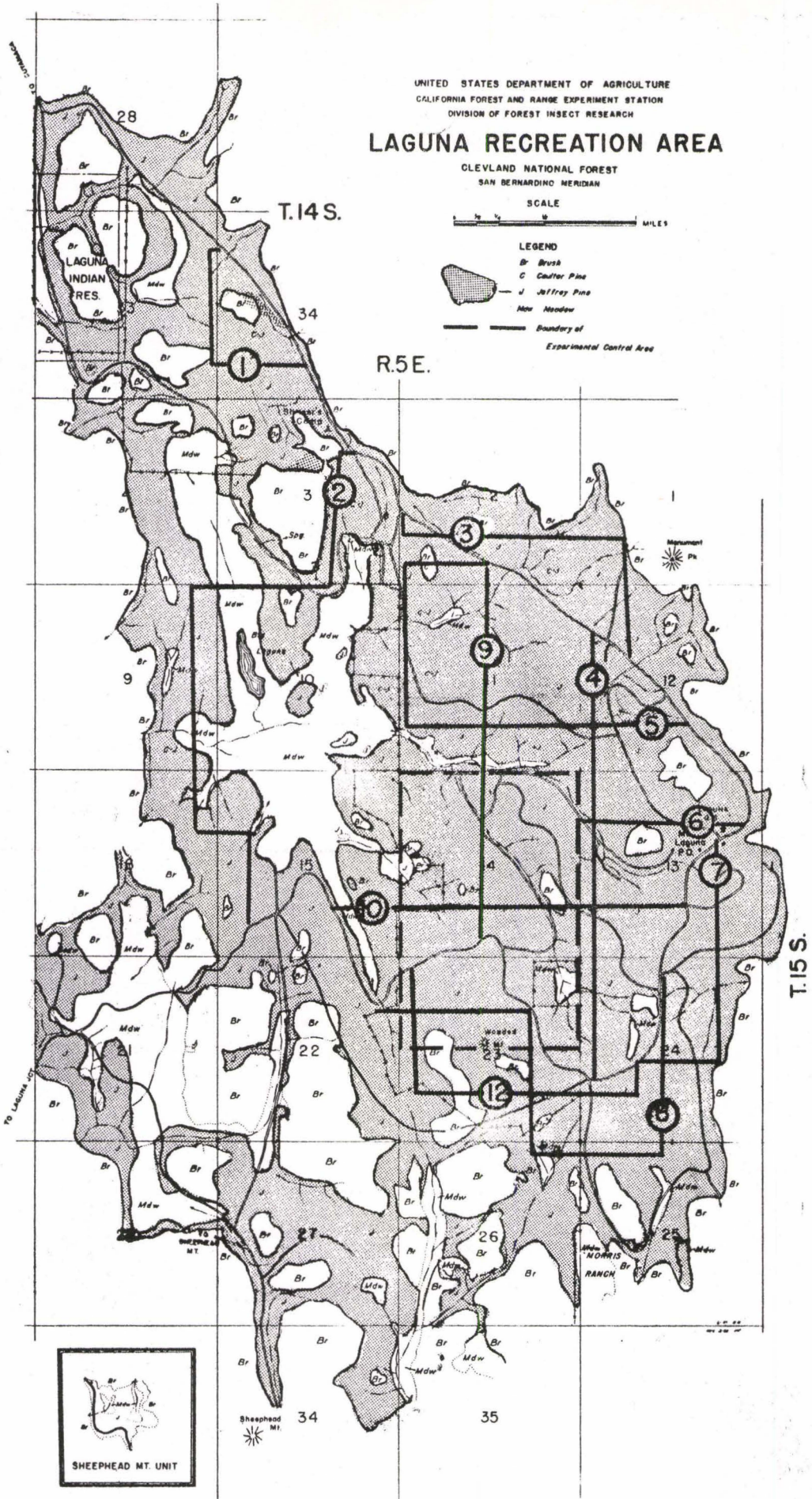
Diameter	Number of injured trees[2/]	Number of trees infested with flatheaded borers			Number of trees infected with dwarfmistletoe				Percent of borer-infested trees with	
		Incipient larvae	Fast-growing larvae[3/]	Percent of total	Light	Medium	Heavy	Percent of total	Light or no mistletoe	Medium or heavy mistletoe
Inches										
2	91	2	46(23)	53	10	11	32	58	48	52
4	83	8	47(24)	66	7	8	36	61	30	70
6	45	2	31(14)	75	10	6	17	73	52	48
8	26	2	15(8)	65	7	7	5	73	47	53
10	18	4	7(3)	61	5	4	5	78	78	22
12	19	3	11(9)	74	5	3	6	74	55	45
14	21	1	16(11)	81	4	5	9	86	25	75
16	16	1	13(5)	88	6	2	6	87	46	54
18	13	0	9(6)	69	4	1	7	92	40	60
20	4	0	4(1)	100	0	1	3	100	0	100
22	1	0	1(0)	100	0	0	1	100	0	100
24	2	0	2(0)	100	0	0	1	50	50	50
26	2	0	2(1)	100	0	1	0	50	50	50
28	5	0	4(0)	80	1	1	2	80	25	75
30	1	0	1(0)	100	0	0	0	0	100	0
32	1	0	1(0)	100	0	1	0	100	100	0
34	5	0	5(1)	100	1	1	1	60	67	33
36	1	0	1(0)	100	0	0	0	0	100	0

1/ Basis: 396 half-acre plots.
2/ From all causes.
3/ Figures in ( ) represent number of trees showing work of woodpeckers searching for flatheaded borer larvae.

Table 3.--Frequency of branch killing in different parts of crown in trees on sample plots, by diameter class.[1/] Mt. Laguna Recreational Area

Diameter	Number of injured trees[2/]	Branch killing in upper crown: Number of trees	Branch killing in upper crown: Average number of dead branches per tree	Branch killing in upper or midcrown: Number of trees	Branch killing in upper or midcrown: Average number of dead branches per tree	Branch killing in upper, mid or lower crown: Number of trees	Branch killing in upper, mid or lower crown: Average number of dead branches per tree	Trees with one or more dying branches: Number	Trees with one or more dying branches: Percent[3/]
Inches									
2	91	4	1.5	8	1.5	3	1.7	9	9.9
4	83	4	2.8	15	2.3	15	2.5	19	22.9
6	45	1	1.0	15	2.3	10	2.2	16	35.5
8	26	1	1.0	5	3.2	6	3.0	8	30.8
10	18	0	-	1	7	4	1.5	5	27.8
12	19	0	-	5	1.2	3	3.0	6	31.6
14	21	1	1	4	2.5	2	3.0	6	28.6
16	16	1	1	2	2.5	6	1.8	6	37.5
18	13	0	0	2	3.5	3	6.0	5	38.5
20	4	1	2.0	2	2.0	1	3	3	75.0
22	1	1	3.0	1	3.0	1	4	1	100.0
24	2	1	1.0	1	2.0	2	1.5	2	100.0
26	2	0	-	0	-	0	-	0	-
28	5	0	-	0	-	2	2	2	40.0
30	1	0	-	0	-	0	-	0	-
32	1	0	-	0	-	1	3	1	100.0
34	5	1	4.0	1	1.0	1	6	3	60.0
36	1	0	-	1	3.0	0	0	1	100.0

1/ Basis: 396 half-acre plots.
2/ From all causes.
3/ Based on total injured from all causes.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LAGUNA RECREATION AREA
CLEVLAND NATIONAL FOREST
SAN BERNARDINO MERIDIAN
SCALE
MILES
LEGEND
Br Brush
C Coulter Pine
J Jeffrey Pine
Mdw Meadow
Boundary of
Experimental Control Area
T.14 S.
R.5 E.
T.15 S.
LAGUNA INDIAN RES.
Shingle's Camp
Monument Pk.
Laguna P.O.
Meadow
MORRIS RANCH
Sheephead Mt.
SHEEPHEAD MT. UNIT
To Laguna